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Western Europe: Coping With Natural Gas Disruptions

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A Research Paper

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Western Europe: Coping With Natural Gas Disruptions

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A Research Paper

This paper was prepared by [] of the
Office of Global Issues. Comments and queries are
welcome and may be directed to the Chief,
Strategic Resources Division, OGI []

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**Western Europe:
Coping With Natural
Gas Disruptions**

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Summary

*Information available
as of 30 October 1983
was used in this report.*

In our judgment, dependence on imported natural gas from non-OECD sources in the 1980s will increase Western Europe's vulnerability to a natural gas cutoff. The International Energy Agency (IEA) reports continental West European gas purchasers may be importing more than 40 percent of their total gas supplies from the Soviet Union and Algeria by 1990. Detailed simulations of the West European gas distribution system suggest that the integrated gas network can meet most of the demands of gas disruptions from the Soviet Union and Algeria. To effectively use the physical distribution system during a disruption, however, will require a degree of regional planning and cooperation that is antithetical to the national perspectives held by the West Europeans.

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Under present gas distribution policies, any Soviet gas embargo during the peak demand winter months could cause minor gas shortages in certain areas even though the physical distribution system would otherwise be adequate. Even under favorable circumstances, including extensive regional planning and cooperation, a simultaneous Soviet and Algerian embargo lasting six months—in which Algeria might seek economic leverage from Soviet action—would severely strain the West European gas network by the end of the decade. Such an embargo would require peak production from all domestic sources, including the Netherlands. At the end of a joint Soviet-Algerian embargo lasting 12 months, storage would be severely depleted, leaving Europe extremely vulnerable to any additional supply problems. Comprehensive regional planning and cooperation could alleviate some of the effects of such major supply disruptions. Moreover, we believe awareness of such planning might discourage gas exporters from even attempting an embargo.

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Until West European governments view gas supply availability in a regional strategic perspective, the coordination necessary to use effectively Europe's gas system during a disruption is highly unlikely. Even in recent months, West European countries have been reluctant to share proprietary information on gas contracts with the IEA, claiming the need to protect against both commercial and domestic political backlash. Implementation of current national West European gas supply emergency plans—which vary widely in scope and depth—could even aggravate shortages in other countries during a major disruption.

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November 1983

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For the 1990s, Western Europe has several options for coping with possible supply interruptions and growing gas demand, but the long leadtime on these efforts requires prompt regional cooperation:

- Developing the North Sea gasfields.
- Establishing Groningen as a regional strategic gas reserve.
- Eliminating physical bottlenecks in the European gas system.
- Financing new gas projects in other regions.

Although the options are not justifiable economically, failure to adopt at least some could seriously limit Western Europe's ability to cope with a major gas embargo—even with coordinated emergency planning—during the 1990s.

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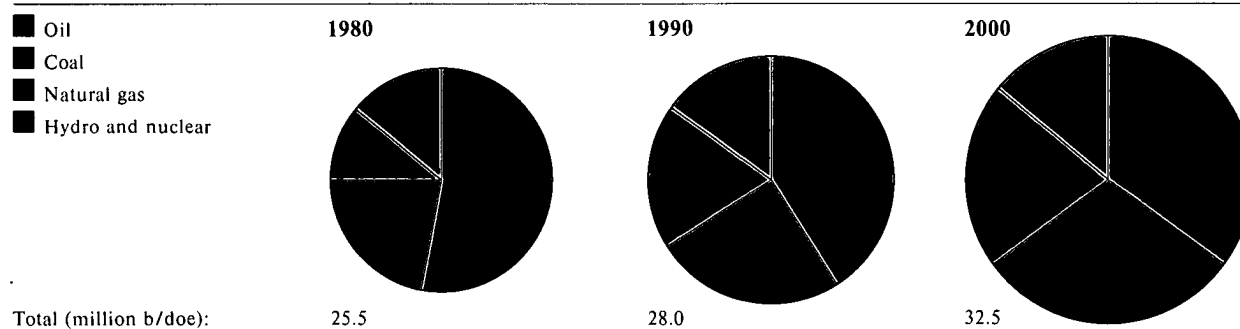
Contents

	<i>Page</i>
Summary	iii
Introduction	1
Gas Supply/Demand Outlook in 1990	1
Europe's Gas Grid	4
Coping With Disruptions	5
Production Flexibility	5
Gas Demand Flexibility	6
Gas Storage	6
Contingency Plans	7
Supply Disruption Scenarios	8
Soviet Embargo	8
Algerian Embargo	9
Soviet-Algerian Embargo	10
Bottlenecks in the European Gas Grid	11
Belgium, France, and Spain	11
Italy and Switzerland	12
Germany and Austria	12
The Need for Cooperation	12
European Options	13
North Sea Gasfields	13
Strategic West European Gas Reserves	14
Eliminating Bottlenecks	14
Non-European Gas Supplies	14

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Figure 1
Western Europe: Energy Projections



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Western Europe: Coping With Natural Gas Disruptions

Introduction

Natural gas is expected to play an increasingly important role as Western Europe attempts to fulfill its energy requirements, yet avoid heavy dependence on expensive imported oil. The share of gas in total energy use has increased from 2 percent in 1960 to about 15 percent, where it is expected to remain stable throughout the decade. Gas consumption for all countries in Western Europe is projected to approach 260 billion cubic meters (BCM)—up from about 200 BCM in 1982 (figure 1). Growth in gas demand, however, will vary greatly by sector and country.

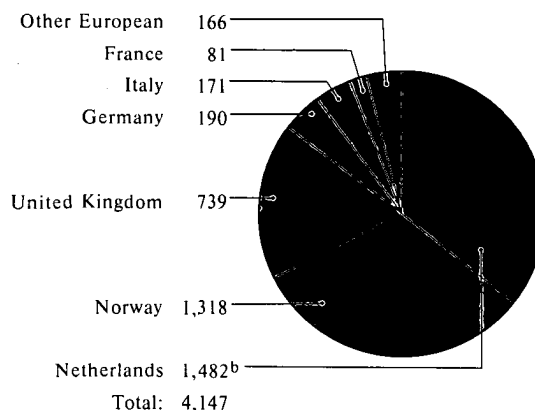
With the increasing gas demand has come growing West European reliance on gas imports from non-OECD sources—currently about one-sixth of total demand. The Soviet Union, with approximately 12 percent, and Algeria, with about 4 percent, are by far the most important non-OECD suppliers of the natural gas consumed in Western Europe. On the continent, the Dutch Groningen gasfield is the principal source of gas for continental Europe, while Norwegian gas from the North Sea provides important supplies to the United Kingdom and, through West Germany, to the continent. Because of reserve or pipeline constraints, however, the bulk of Western Europe's increasing natural gas demand will have to be satisfied by Algeria and the USSR. In view of this growing dependence on non-OECD gas suppliers and past Soviet and Algerian disruptions, Western Europe's largest gas importers—France, West Germany, and Italy—will become increasingly vulnerable to natural gas disruptions.

Gas Supply/Demand Outlook in 1990

Industry estimates of total West European gas consumption approximate 245 BCM in 1985 and 260 BCM in 1990—an annual growth of less than 2 percent. The decline in West European gas consumption from about 220 BCM in 1980 to 200 BCM in 1982, however, means that gas demand growth can be expected to average about 3 percent annually from

Figure 2
Western Europe: Proven Natural Gas Reserves^a

Billion cubic meters



^a As of January 1981.

^b Closer to 2 trillion cubic meters due to recent increases in reserve estimates for Groningen.

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1982 to 1990. All major West European countries, except the United Kingdom, are expected to register substantial increases in gas demand during the decade. A reduction in gas infrastructure investment, however, could reduce the rate of gas demand growth in Italy in the early part of the period.

Industry projections of indigenous gas production in Western Europe hover around 190 BCM in 1985 and 175 BCM in 1990. These production estimates are more optimistic than previous forecasts, largely because of industry expectations that Dutch gas production in 1990 will be higher than previously anticipated—The Hague has recently liberalized its gas export policy because of increased reserves and lower domestic consumption projections (figure 2). Production estimates for the United Kingdom have also increased slightly because of recent North Sea tax modifications.

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***A Methodological Note:
Simulating the West European
Gas Distribution System***

West European countries began concluding contracts for additional gas supplies from the USSR in 1981. These supplies, in addition to existing contracts for Soviet gas, significantly increased the level of West European dependence on Soviet imports and raised questions among US officials about the security of gas supplies. At the insistence of the US Government, the International Energy Agency (IEA) agreed in late 1982 to study the adequacy of the gas distribution network to handle a supply disruption to the IEA countries. [redacted]

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At the same time, the US Department of State requested that the Central Intelligence Agency independently verify the results of the IEA study. [redacted]

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[redacted]

We adapted the industrial computer simulation model to evaluate the physical capability of the network to balance supply and demand during a variety of disruption scenarios occurring around 1990. The model represents the critical gas production, import, storage, transmission, and compression facilities in Western Europe. Physical constraints, such as pipeline capacity under varying conditions and production rate limits, are automatically considered by the model in computing supply and delivery flows. [redacted]

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Scenarios Investigated:

- *A North Sea interruption.* Dutch exports increased from 32 to 50 BCM.
- *A Soviet export embargo.* Algerian exports increased from 27 to 32 BCM.
- *An Algerian embargo.* Soviet exports increased from 55 to 65 BCM.
- *A simultaneous Soviet-Algerian embargo.* Dutch exports increased from 32 to 74 BCM. [redacted]

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It is assumed that any gas-producing country not participating in an embargo would increase its exports to the maximum physical limit and that imports from other non-OECD sources would not significantly improve the supply situation until after 1990. [redacted]

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Objective

- To determine if projected demand could be met during periods of disruption by:
- Combining storage withdrawals.
 - Increasing domestic production.
 - Increasing imports from nonembargoed sources. [redacted]

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Key Assumptions:

- *Storage.* Major facilities presumed full at beginning of disruption. Withdrawals limited to capacity and physical rates planned for 1990. During slack demand periods—summer months—storage recharged, if sufficient excess gas available.

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- *Demand.* Projections continually revised. Relatively high projections used for slightly colder than normal winters. Demand estimated on quarterly basis for each country and presumed to remain at normal level unless country directly affected by an embargo. If affected, demand during embargo reduced by amount of seasonally adjusted interruptible gas demand within country, estimates of which derived from IEA study. Use of low-calorie gas from the Netherlands assumed to pose no major technical problems for consumers.
- *Domestic Production.* Each country limited to projected normal level unless directly affected by disruption. Affected countries' production increased by estimated amount of surge potential, derived from IEA study.
- *Disruption Length and Timing.* Six months—1 October to 1 March—to test system's ability to handle demands during disruption. Twelve months—beginning 1 July—to test system's ability to withstand protracted disruption.
- *Pipeline Network.* All major pipelines planned for 1990, including Spain into southern France connection.
- *System Utilization.* Optimized within physical constraints during each scenario. Actions of individual governments that could aggravate shortages in other countries not considered.
- *West European Cooperation.* Assumed all governments cooperated extensively, particularly if directly affected. Domestic production allowed to surge and interruptible services curtailed only in affected countries. Unaffected countries limited cooperation to participation in swapping arrangements except for the Netherlands, which allowed full production capacity at Groningen gasfield to offset interrupted supplies. Full-scale cooperative political efforts, including demand restraint and gas-sharing provisions similar to those for oil under the IEA Emergency Sharing Plan, were not considered to be in effect.

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The 1990 allocation of gas supplies will vary depending on domestic gas production and consumption. The assumed balance for supply and demand of natural gas in 1990 are:

	Domestically Consumed Production	Netherlands	USSR	Algeria	Libya	Norway	Total Demand
Total ^a	105	32	55	27	1	38	257
Netherlands	32					3	35
Austria	1	1	5				6
Belgium	NEGL	3				3	6
Germany	16	15	22			10	62
France	4	6	13	9		3	35
Italy	10	6	15	12			43
Luxembourg		1					1
Spain	1			5	1		8
Switzerland	NEGL	2					2
United Kingdom	41					18	59

^a Totals may not add because of rounding.

Table 1
Major West European Pipelines

	Location	Length (km)	Diameter (cm)
Tenp	Groningen Field (Netherlands)-Aachen (German border)	342	96/71 ^a
	Aachen (German border)-Rheinfelden (Swiss border)	500	96
	Rheinfelden (Swiss border)-Sackingen (Italian border)	160	86
	Sackingen (Italian border)-Mortara (Italy)	156	86
	Hilvarenbeek (Dutch border)-Taisnieres (Belgian border)	170	91 ^a
	Taisnieres (Belgian border)-Paris (France)	242	91 ^a
Megal	Waidhaus (German border)-Medelsheim (French border)	460	120/80 ^a
	Medelsheim (French border)-Voisines (France)	220	120/90 ^a
Wag	Baumgarten (Austrian border)-Oberkappel (German border)	250	80
Tag	Baumgarten (Austrian border)-Tarvisio (Italian border)	382	96/91 ^a
	Tarvisio (Italian border)-Sergnano (Italy)	485	120/86 ^a
Transmed	Hassi R'Mel (Algeria)-Cape Bon (Sicily)	916	123
	Cape Bon (Sicily)-Marzara (Italy)	160	51
	Marzara (Italy)-Minerbio (Italy)	1,514	123

^a Several lines are parallel; the number and diameters of lines vary with location.

the midrange of consumption and production projections for 1990 suggest Western Europe could require net natural gas imports of only 67 BCM in 1990—about 20 percent less than anticipated. Gas supplies available from the Soviet Union, Algeria, and Libya, however, could easily total as much as 83 BCM by 1990. This perceived surplus in available gas supplies will encourage some West European countries to reduce or defer purchases of imported gas or shut in domestic production. The surplus could also delay or prevent development of more costly North Sea gasfields needed to limit dependence on non-OECD gas supplies. Should demand in 1990 prove greater than anticipated, Western Europe may find the only readily available supplemental gas supplies are from the USSR and Algeria—the suppliers most likely to disrupt gas supplies for political or economic reasons.

Europe's Gas Grid

In our judgment, the major gas pipelines in Western Europe are capable of transporting domestic and imported gas wherever needed (see map). The largest developed gas reserves in Western Europe are located in the Netherlands at the Groningen gasfield, from which major transmission lines extend south through Belgium into France. The Trans-European Natural Gas Pipeline (Tenp) runs north-south through Germany, transporting gas from the Netherlands and Norway through Germany and Switzerland into Italy. The Middle European Gas Pipeline (Megal) system carries Soviet gas across Germany into France. The large capacity of the Megal system makes it one of the major links in the West European network. The

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Previous Gas Interruptions

Western Europe has already weathered several gas supply interruptions with little difficulty:

- *In early 1980 Algeria stopped all LNG deliveries to France—ostensibly because of technical problems in the gas liquefaction plants at Skikda and Arzew. French officials, however, viewed the action as an effort to force France to agree to double the price for Algerian gas.*
- *Libya halted LNG shipments to Italy in August 1980 because of price disputes.*
- *In January 1981 the Soviet Union reduced exports to Western Europe by 30 percent because of surges in Soviet winter demand.*

Temporary Soviet cutbacks of gas deliveries to Western Europe have been a recurrent problem, even though Moscow has always met contractual obligations on an annual basis. West European countries were able to alleviate these shortfalls by increasing imports from the Netherlands and curtailing service to interruptible customers.

West Austrian Gasleitung (Wag) system carries Soviet gas across northern Austria into Germany, where it links with the Megal system. The Trans-Austria Gasleitung (Tag) transports Soviet gas through southern Austria into Italy. The Trans-Mediterranean pipeline (Trans-Med) crosses the Mediterranean Sea into Italy from Algeria.

Spain will also probably be connected to the European network via a line from Barcelona into southern France by 1990.

Coping With Disruptions

Western Europe's natural gas system permits some flexibility in coping with supply losses:

- The surplus production potential in a few countries can be tapped.
 - Subject to substantial seasonal and sector constraints, gas demand can be adjusted.
- Substantial storage capacity can be used.

Table 2
OECD Europe: Domestic Gas Production

Billion cubic meters

	1980 Normal	1990 (Estimated)	
		Normal	Surge
Total ^a	197	174	249
Austria	2	1	1
Belgium	1	NEGL	NEGL
France	11	4	4
Germany	19	16	17
Italy	13	10	11
Netherlands	90	64	132
Norway	25	38	38
Spain	NEGL	1	1
Switzerland	NEGL	NEGL	NEGL
United Kingdom	37	41	45

^a Totals may not add because of rounding.

Production Flexibility

Although almost every country in Europe has some gas production, the Netherlands, the United Kingdom, Norway, and West Germany have the greatest gas production potential. During a major supply disruption, each country should be able to surge production at least 5 to 10 percent above normal levels for a sustained period (table 3). Except for the Netherlands, however, we believe it unlikely that any West European country not directly affected by the disruption would surge domestic gas production to help another country because most countries strictly observe a domestic-use policy. Although Norway's North Sea gas reserves are substantial, we expect that delivery of gas to continental Europe will be constrained to existing pipeline capacity of 20 BCM well beyond 1990.

Gas Demand Flexibility

The European gas distribution network was designed to accommodate fluctuations in demand. In Western Europe the weather and the number of consumers using gas for space heating can cause peak winter gas

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Table 3
Projected Netherlands Gas
Allocations in 1990 ^a*Billion cubic meters*

Supplies	73
Production	64
Onshore	48
Offshore	16
Imports from Norway	9
To the Netherlands	3
To France and Belgium	6
Demand	73
Consumption	35
Exports	39
Reexports of Norwegian gas	6
Austria	1
Belgium	3
France	6
Germany	15
Italy	6
Luxembourg	1
Switzerland	2

^a Totals may not add because of rounding.

demand to be more than three times greater than summer demand. Daily gas demand can fluctuate even more during the early morning and evening when residential demand is highest.

Natural gas use is split among three major sectors: residential, heavy industrial, and electric power generation. Many of the industrial and utility users receive gas service on an interruptible supply basis—in exchange for lower prices, users agree to allow supplies to be terminated on short notice. Nearly all gas users served on this basis have made provisions for using alternative fuels. On the European mainland, these service interruptions could reduce demand by about 10 percent, or more than 20 BCM, per year during a yearlong emergency. During the winter months, however, this flexibility is severely reduced—to less than 5 BCM—because many of the interruptible services have already been routinely terminated. Conservation and demand restraint measures, such as limiting

The Role of Dutch Gas

Western Europe will continue to depend on the Netherlands—the largest gas producer on the mainland—for surge production on the continent. Dutch gas production comes primarily from the Groningen field, which contains 85 percent of proven Dutch gas reserves. Total Dutch gas production is expected to decline from 90 BCM to about 64 BCM by 1990 because of The Hague's policy to save the Groningen field as a strategic domestic gas reserve. Recent Hague decisions to permit the extension of some foreign contracts, however, may reflect a new trend to permit higher production. Annually, the Netherlands is technically capable of sustained gas production of more than 130 BCM. Moreover, the transmission network is capable of sustained exports of more than 100 BCM per year, although bottlenecks in neighboring countries could limit exports to 74 BCM annually, according to our analysis. Although maximum field deliverability will decline slightly with continued production, this field should remain capable of substantial increases in production well beyond 1990. This additional surge capacity could alleviate the effects of an import disruption throughout Europe, if the Dutch are willing to allow such high levels of production.

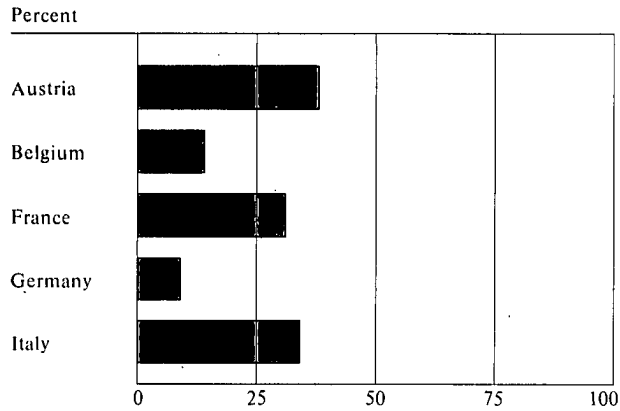
hours of gas service and establishing allocation priorities, could reduce demand even more, if implemented in a timely manner and strictly enforced.

Gas Storage

Because gas demand fluctuates widely on a daily and seasonal basis, the European gas network includes substantial gas storage to balance supply and demand. Approximately 75 percent of West European storage capacity is in France and Italy. Storage facilities are commonly located close to points of peak demand and are filled during the low-demand months, allowing production and transmission facilities to be designed for average, rather than peak conditions.

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Figure 3
Projected Gas Storage as a Percent of
Annual Consumption in 1990



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According to IEA studies, the primary gas storage facilities in Europe¹ should accommodate about 34 BCM by 1990. Austria, Italy, and France will each have enough storage to accommodate about one-third of their gas needs for one year. Although Germany could only cover about 10 percent of its annual needs, it will continue to have ready access to additional gas from the Netherlands, as do Switzerland, Belgium, and Luxembourg. Spain will remain the only European nation without any effective storage or contractual access to gas supplies from the Netherlands. The flexibility of the European gas network, however, allows gas to be withdrawn from almost any storage location in Europe through complex gas swapping arrangements. Spain will be able to take advantage of this capability once its connection to the West European gas grid in southern France is completed in the next few years.

Contingency Plans

Despite the flexibility of the West European gas system as a whole, emergency gas planning has proceeded only on a national basis. The variety in national gas disruption response planning is evident by the following IEA illustrations:

- Austria has not established any significant gas emergency plan.

¹ Includes Austria, Belgium, France, Germany, and Italy.

- Belgium has contingency plans for 10- and 20-percent gas supply disruptions. The emergency measures are contained in Belgium's Civil Defense Plan. A province-by-province plan is being studied and a list of gas users to be given supply priority during emergencies has already been established.

- France will rely primarily on its gas storage capacity and interruptible demand during an emergency. By 1990 France will have the greatest gas storage capacity in Europe, and Gaz de France is planning to increase its interruptible contracts from 15 percent of current total gas demand to 20 percent.

- West Germany prefers to act through industry and has created a clearing body to coordinate private efforts. Should industry be unable to balance supply and demand, government units can directly intervene in production, purchasing, and gas sales, as well as establish consumption priorities.

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- Italy will use its state-owned gas companies to coordinate management of all energy resources during an emergency, including storage and building or upgrading production facilities for exclusive use in an emergency.

- The Netherlands has not established any emergency plan other than a general policy to safeguard the flexibility of domestic production by conserving gas from Groningen and maximizing output from other Dutch gasfields.

- Switzerland has formed a government/industry group that is establishing criteria for demand restraint priorities. At present, there are no firm plans for strategic storage, surge capacity utilization, or other direct supply actions.

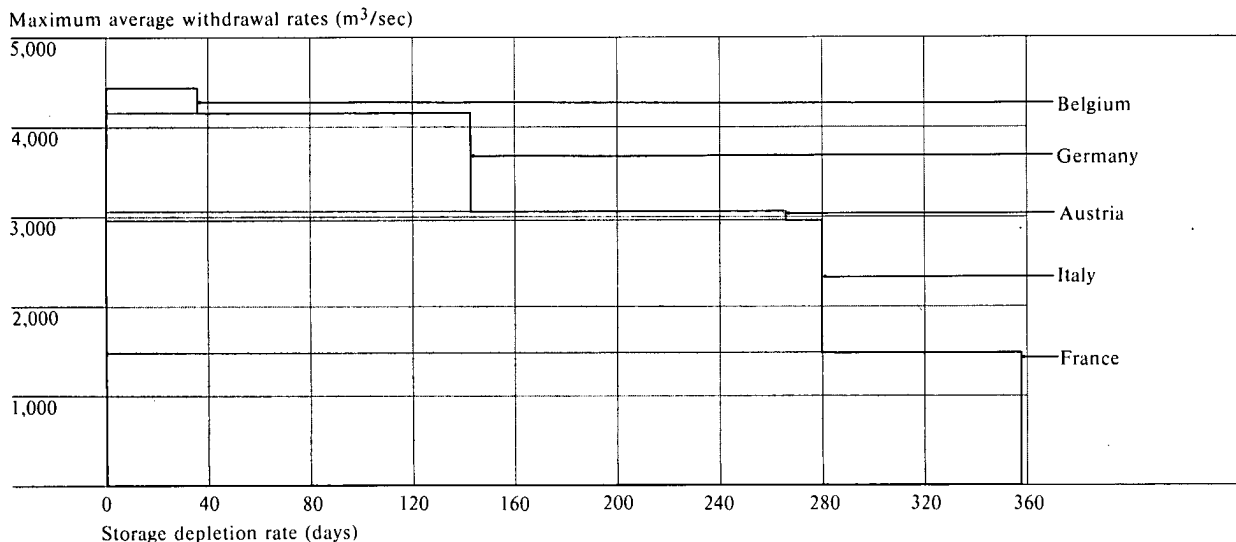
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- Spain will rely primarily on interruptions of dual-fired industrial users to reduce demand in an emergency. Since 1980 new residences have been required to have dual-fired capability to burn propane or butane, if natural gas is not available.

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Figure 4
Projected European Gas Storage in 1990



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- The United Kingdom can regulate energy use if required, however, measures are not established in advance. London will rely primarily on its surplus production capacity, storage, and interruptible demand during an emergency. There are no specific plans for surge production or fuel switching, except as already encompassed by interruptible contracts.

Supply Disruption Scenarios

Even with the well-developed national emergency plans, the flexibility of the West European natural gas system will steadily erode as gas demand begins to approach the system's capacity toward the end of the decade. Under these circumstances, Moscow and Algiers will add to their political and economic leverage by becoming the primary surge gas suppliers in the event of demand surges or temporary supply problems in the European grid. Beyond this, however, these countries are also in the best position to seriously disrupt West European gas supplies. The following,

based on a comprehensive analysis, looks at Soviet, Algerian, and joint Soviet-Algerian embargoes and assesses the supply consequences for Western Europe, without accounting for any political or contractual constraints that might impede the flow of gas between countries.

Soviet Embargo

Moscow is committed to deliver about 48 BCM annually by 1990. In a high-demand scenario, however, the Soviet Union could be exporting about 55 BCM of gas to Western Europe—roughly two-thirds of all imports from non-OECD suppliers. A total embargo of Soviet gas would severely affect Austria, France, Germany, and Italy. Barring serious system failures, most European nations could deal with such an embargo.

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Table 4
Projected 1990 Continental European Gas Balance
During a Soviet Embargo ^a

Billion cubic meters

	Six Months ^a		12 Months ^b	
	Normal	Embargo	Normal	Embargo
Demand ^c	123	120	198	177
Supplies	123	120	198	177
Import sources	57	34	103	53
Algeria	14	23	27	32
Libya	1	1	1	1
Norway	10	10	20	20
USSR	32	0	55	0
Regional sources	62	76	95	123
Netherlands	46	59	64	88
All others	16	17	31	35
Net storage withdrawals	4	10	0	2

^a Excludes UK and Scandinavia.^b Six-month period begins 1 October; 12-month period begins 1 July.^c Adjusted seasonally for additional interruptible demand.

Note: Totals may not add because of rounding.

West Germany—the largest importer of Soviet gas—could meet its demand by increasing domestic production and imports of gas from the Netherlands. France could surge domestic production and accelerate imports from Algeria. During a long embargo, it could be forced to use storage or to conserve by refusing aid to Spain. The other small European nations could increase exports from the Netherlands.

Italy and Austria—too dependent on Soviet gas to have all their needs provided for by increasing imports of gas from the Netherlands—will have to use storage. Under the high-demand scenario the Soviet Union could be supplying as much as 35 percent of Italian demand and 75 percent of Austrian demand by 1990. Net storage withdrawals of about 10 BCM—more than 65 percent of capacity—would be absolutely necessary during the winter in Austria and Italy, even if all interruptible services were terminated and strict conservation procedures invoked.

Algerian Embargo

We expect Algerian gas exports to Western Europe to exceed 25 BCM by 1990. Although a disruption of gas sales to Western Europe would cost Algeria about \$400 million each month in lost revenues that it can ill afford, Algiers may believe the opportunity to extract long-term price concessions from customers is worth the short-term risk. Over half of the imported gas from Algeria will be in the form of LNG; the remainder will be natural gas transported to Italy through the Trans-Mediterranean pipeline. By 1990 Algerian gas could supply about 60 percent of Spanish consumption, 30 percent of Italian consumption, and more than 25 percent of French consumption. Even with this level of dependence, an embargo can be adequately compensated for by increasing domestic production and imports from the Netherlands and the

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Table 5
Projected 1990 Continental European Gas Balance
During an Algerian Embargo ^a

Billion cubic meters

	Six Months ^b		12 Months ^b	
	Normal	Embargo	Normal	Embargo
Demand ^c	123	121	198	186
Supplies	123	121	198	186
Import sources	57	44	103	86
Algeria	14	0	27	0
Libya	1	1	1	1
Norway	10	10	20	20
USSR	32	33	55	65
Regional sources	62	73	95	100
Netherlands	46	56	64	68
All others	16	17	31	32
Net storage withdrawals	4	4	0	0

^a Excludes UK and Scandinavia.^b Six-month period begins 1 October; 12-month period begins 1 July.^c Adjusted seasonally for additional interruptible demand.

Note: Totals may not add because of rounding.

Soviet Union. Net storage withdrawals of about 4 BCM—more than one-third its available storage—would be required in France during the winter, even if all interruptible services were terminated by Gaz de France and effective conservation procedures invoked by the government.

Soviet-Algerian Embargo

A simultaneous Soviet and Algerian embargo in 1990 could cripple Western Europe. The Soviets—for political, economic, or technical reasons—might shut off the gas flow to Western Europe, and Algeria could seize this opportunity to extract price concessions from its customers by halting deliveries. The impact would primarily be felt by industrial and residential gas users. We expect combined Soviet and Algerian gas exports to comprise about 40 percent of continental West European gas consumption in 1990. Nonetheless, should the Netherlands be willing to produce gas at much higher than normal levels, Western Europe physically has enough production and storage

capacity to survive a yearlong Soviet-Algerian embargo. At the end of that time, however, storage would be severely depleted, just as the next peak demand period approached

Storage withdrawal of 22 BCM—about 70 percent of total storage capacity—would be required to meet projected demand, even with all affected countries increasing domestic production. Storage in France and Italy would be virtually depleted and West Germany would be forced to use more than 20 percent of its stored gas supplies. The Netherlands would have to produce at near-maximum physical capacity during peak demand periods and average more than double the annual export rate it currently plans. If West European countries act decisively to limit demand by implementing coordinated emergency plans at the start of the embargo, the time they could withstand

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Table 6
Projected 1990 Continental European Gas Balance
During a Soviet-Algerian Embargo ^a

Billion cubic meters

	Six Months ^b		12 Months ^b	
	Normal	Embargo	Normal	Embargo
Demand ^c	123	117	198	176
Supplies	123	117	198	176
Import sources	57	11	103	21
Algeria	14	0	27	0
Libya	1	1	1	1
Norway	10	10	20	20
USSR	32	0	55	0
Regional sources	62	84	95	141
Netherlands	46	67	64	106
All others	16	17	31	35
Net storage withdrawals	4	22	0	14

^a Excludes UK and Scandinavia.^b Six-month period begins 1 October; 12-month period begins 1 July.^c Adjusted seasonally for additional interruptible demand.

Note: Totals may not add because of rounding.

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the disruption would be substantially lengthened. If not, West European countries would not have sufficient gas in storage to meet demand during the second winter of an extended embargo.

Bottlenecks in the European Gas Grid

The pipeline system in Western Europe is an integrated distribution network capable of transporting enough gas from almost any storage, production, or import facility in Western Europe to meet demand requirements in any area under normal conditions. Under our scenarios, which require surge flows, however, several bottlenecks would restrict the system's ability to move large quantities of gas from the Netherlands to southern Europe. These system restrictions could force some countries—Italy and Austria, in particular—to rely more heavily on stored gas during a disruption.

pipelines from Germany and Belgium. Indeed, when flows from both pipelines are simultaneously increased, neither pipeline can reach maximum capacity. The problem is most apparent when LNG supplies from Algeria are disrupted causing Soviet and Dutch gas to be transported to southern France from the north. Linking Spain to the European network through France merely increases delivery problems for France. To meet Spanish gas requirements during an Algerian disruption, France would probably have to swap gas—using gas from storage in southern France—to supply Spain in exchange for gas from the Soviet Union or the Netherlands contracted for by Spain. A connection between France and Italy would greatly enhance the network's ability to transport Soviet gas to southern France and Spain.

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Belgium, France, and Spain. Our model indicates that restricted line capacities will severely limit France's ability to import additional gas through

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Table 7 *Billion cubic meters*
Projected Effects of Gas Network
Bottlenecks

	Additional Storage Withdrawals Required ^a	
	Six Months	12 Months
Soviet embargo	10	2
Algerian embargo	4	0
Soviet-Algerian embargo	5	13

^a Six-month period begins on 1 October; 12-month period begins on 1 July.

Italy and Switzerland. In Switzerland, according to our model, limited pipeline capacity restricts Italy's ability to import Dutch gas or export Algerian gas. Likewise, the internal distribution system in northern Italy consists primarily of a diffuse network of small diameter pipelines. While this may facilitate distribution within the region, it also increases the difficulty of moving large volumes of gas through the region. Shipments through the pipeline from Algeria could be increased significantly by adding additional compression capacity. Without this additional capacity, Italy will remain heavily dependent on its gas storage.

Germany and Austria. Germany will not be seriously affected by a loss of any single supply source because of its proximity to Norwegian, Dutch, and Soviet gas. During a simultaneous Soviet and Algerian embargo, our model shows it would be necessary to use the existing reverse flow capabilities on sections of the Megal and Wag gaslines across Germany into Austria. Once the minor operational difficulties from reversing the direction of flow were solved, the lines could carry sufficient gas from the Netherlands to meet all of Austria's and part of Italy's needs. Additional compression on the lines through Austria would ease the flow of gas from the Netherlands to Italy.

The Need for Cooperation

We believe Western Europe's natural gas system is sufficiently versatile to cope with the effects of almost any gas supply disruption through 1990; however, effective use of that capacity requires substantial regional cooperation. West European governments have been unwilling to cooperate to achieve the efficient emergency use of the available gas system. Under current emergency planning, each West European country will respond to an embargo only if it is directly affected; no provisions have been made for effective coordination or cooperation between countries. Indeed, without coordinated planning, one country's plans could negate the effectiveness of another country's. These conflicting national plans could aggravate the effects of the original disruption. For example, Italy may expect to receive Dutch gas in a Soviet-Algerian disruption, but that gas may already be committed to France or cannot be delivered because Switzerland may preempt the excess pipeline capacity for its own needs.

Coordinated gas emergency planning would have other benefits for regional programs as well. Coordinated gas planning would free substantial financial resources that might otherwise be wasted by adding redundant capacity to national distribution systems. We believe awareness of such planning might also discourage gas exporters from even attempting an embargo.

We doubt, however, that West European governments will cooperate sufficiently to develop the coordinated plans and operating procedures necessary to cope with a major gas supply disruption without a major change in the way they view natural gas—and other energy—issues. Gas supply problems are viewed in a national or bilateral commercial context. Even in matters of national defense, where most West European nations readily acknowledge the continuing need for cooperation, each country staunchly asserts its political autonomy. In areas of potential general economic

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cooperation, the West Europeans have been only moderately successful—for example, the European Economic Community continues to squabble over trade and commodity allocations. [redacted]

In matters the West Europeans perceive to be primarily commercial—such as securing gas supplies—international cooperation is most difficult. Indeed, the IEA's gas security study was seriously hindered because West European governments and their gas companies steadfastly refused to provide what they deemed to be sensitive commercial data. Each country, whether a gas supplier or purchaser, jealously protects the terms of its contracts. [redacted]

[redacted] the Dutch do not want the terms of contracts with their customers known for fear of being whipsawed by other customers seeking more favorable terms. Likewise, gas buyers try to avoid disclosure of contract terms with the USSR and Algeria, so as to avoid political problems at home and abroad. Until the availability of gas becomes a regional strategic issue rather than a commercial question, the cooperation necessary to coordinate emergency gas planning is highly unlikely. [redacted]

Faced with a major gas supply disruption, we believe the West Europeans eventually would cooperate. The mechanisms that would enable Western Europe to fully use or enhance its gas distribution network, however, must be in place well before a disruption. Failure to coordinate national strategies well in advance will only increase demand for gas from storage or alternative oil supplies, as well as increase the potential for spot shortages during a disruption. In our judgment, the termination of additional interruptible gas customers in Western Europe during a gas supply disruption, for example, could increase demand for oil by as much as 350,000 b/d. The additional demand is likely to create short-term pressures on all fuel prices. [redacted]

European Options

Aside from the development of a coordinated approach to emergency gas supply planning, Western Europe could reduce its dependence on imports of Soviet and Algerian gas in the 1990s by:

- Developing the North Sea gasfields.
- Designating the Groningen gasfield in the Netherlands as the strategic gas reserve for Western Europe, until the North Sea gasfields are developed.
- Eliminating the bottlenecks in the gas distribution system.
- Financing development of gas projects in other regions.

Despite this long-term potential, there are substantial political and economic roadblocks to pursuing each of these objectives. [redacted]

North Sea Gasfields

Although there will not be enough North Sea gas by 1990 to offset the effects of a major gas embargo, development of Norway's gas reserves could substantially reduce the effects of a Soviet and Algerian gas embargo after 1990. The Norwegian Government has recently shown a willingness to make substantial volumes of gas available to Western Europe, but it will not move ahead with development until customers are firmly committed to buying the gas. Should the Soviet Union proceed with construction of a second export pipeline or significantly increase capacity of existing lines and adopt an aggressive marketing posture, development of additional North Sea gasfields could be delayed indefinitely.² [redacted]

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Strategic West European Gas Reserves

The Netherlands can continue to be a major exporter of natural gas to continental Europe. In addition to being Western Europe's most reliable and inexpensive source of additional gas, it has a highly flexible gas transmission system and large gas reserves that enable it to cope with extreme fluctuations in peak demand. Despite its export potential, the Government of the Netherlands has adopted policies designed to conserve gas resources. Under these policies, Dutch gas exports will continue to dwindle. [redacted]

Given the size of Dutch gas reserves—about 2 trillion cubic meters since recent upward revisions of Groningen's reserves—and the attractiveness of the potential gas revenues, the current conservation policies are under continuing review by the Dutch Government. Budgetary pressures have already encouraged The Hague to authorize modest extensions of existing contracts, but the Dutch have shown little willingness to unilaterally assume the role of strategic gas reserve for all of Western Europe. Individual countries, such as Germany and Belgium have, however, apparently received private assurances that adequate gas will be available during an emergency. Although the Netherlands may be willing to provide gas during an emergency, we believe they will demand compensation to hold strategic reserves for other countries. Without such compensation, The Hague is not likely to allow additional development for the Groningen gasfield. This additional infield development of Groningen is necessary to increase well productive capacity to maximize use of the existing gas transmission facilities in the Netherlands. [redacted]

Eliminating Bottlenecks

The West European gas distribution network can meet all normal demand requirements through the remainder of this decade. Our analysis shows the system is unable, however, to move large quantities of gas from the Netherlands to southern Europe under some surge flow conditions. Although Italy and Austria are most affected by these system restrictions, France and Spain could also be forced to rely more heavily on stored gas during a disruption. In most cases, the pipeline restriction is located outside the country affected and could be corrected only through international cooperation. [redacted]

Non-European Gas Supplies

Algeria and the Soviet Union are in an excellent position to supply natural gas to Western Europe in the 1990s because of their substantial gas reserves. As much as 12 BCM of gas, however, could be available from a variety of other suppliers, including Cameroon, Nigeria, Qatar, Libya, and Canada. We believe it is increasingly doubtful, however, that any of these projects will proceed. The gas projects under consideration require extensive capital investments and would result in per-unit gas costs substantially higher than gas from existing sources. At the same time, we expect the continued softness in energy markets to keep gas prices down. So long as surplus capacity is available from existing sources at acceptable prices, new projects are unlikely unless West European governments reevaluate their positions on buying additional gas from the USSR and Algeria. Given the likelihood of continued softness in the world gas market, these options cannot be justified on near-term commercial or even regional economic grounds. In a regional strategic perspective, however, completion of these options would provide important redundant capacity to cope with the most severe disruption of natural gas supplies through the balance of the century. Failure to adopt at least some of these options could seriously affect Western Europe's ability to cope with a major gas embargo—even with coordinated emergency planning—during the 1990s. [redacted]

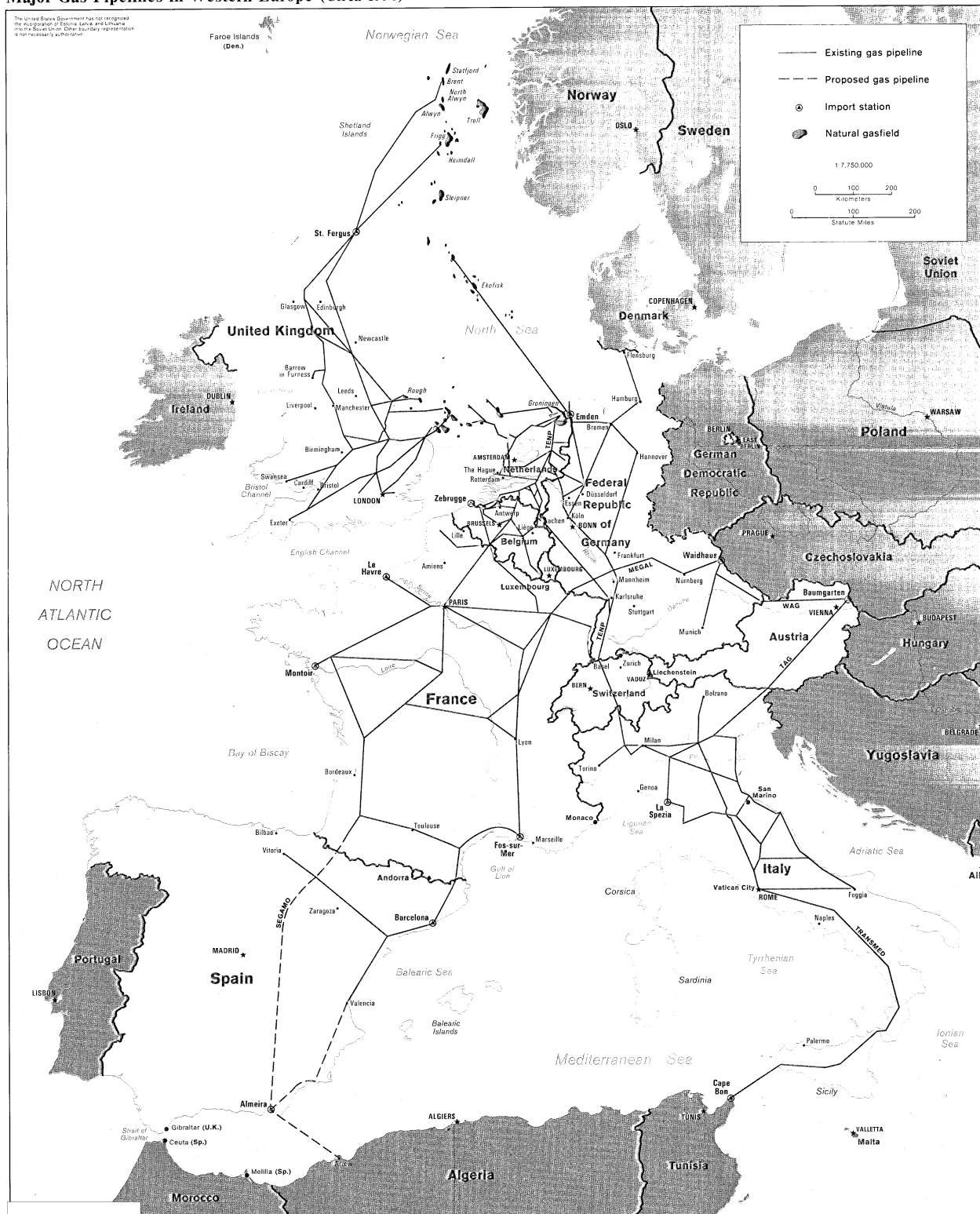
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Major Gas Pipelines in Western Europe (Circa 1990)



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